

A firefighter in full gear, including a helmet and heavy jacket, stands in front of a large, intense wildfire. The firefighter is holding a tool, possibly a shovel or a specialized firefighting tool. The background is filled with bright orange and yellow flames, with some smoke visible. The scene is set in a dry, brushy area.

ENGAGING THE FIRE BEFORE IT STARTS:

A CASE STUDY FROM THE 2017 PINAL FIRE (ARIZONA)

by Christopher D. O'Connor and David E. Calkin

"The work done by the RMRS Wildfire Risk Management Science Team developing the Potential Wildfire Operational Delineations — coupled with the reinforced message and alignment from the Regional Forester, forest leadership, line officers, and local fire managers — gave us the support and tools needed to conduct successful pre-season meetings with our cooperators and stake holders. This was a huge factor in the implementation of the plan as well as alignment with our National Strategic and Forest Plan while managing the Pinal Fire."

— Andrew Mandell, Incident Commander
Central West Zone Type 3 Incident Management Team.

On the afternoon of May 8, 2017, lightning struck a single snag just off of forest road 651, along the main ridge of the Pinal Mountains of southern Arizona, USA. Four weeks later the smoke had cleared and the city of Globe had a 7,500 acre fuel treatment, including 6,600 acres of restored pine forest and woodland, and 700 acres of chaparral brush that was already re-sprouting and wouldn't pose a serious fire threat again for decades.

How did the forest and community get to the point where they were willing to take on managing a fire of this size and duration for resource benefit and hazard reduction? Science has recognized for decades that many forested ecosystems of the American West are shifting away from historically fire-adapted conditions. Beginning in the 1970's a small handful of managers recognized this issue and developed wildland fire use concepts. However, in the current era of increasing encroachment of human development, climate change, and accumulated fuels, uncertain outcomes have emphasized the default response of aggressive suppression.

What if, instead of waiting for a start to formulate a response strategy, land managers had a formal process for developing a range of wildfire response options for an entire landscape prior to the fire season? Response options could be discussed openly between agency administrators, fire staff and resource specialists, and negotiated with



Planning for control opportunities prior to the fire ignition may help to return fire to the landscape. From this initial case study, fire managers in the US Southwest and beyond are adding a process that can return fire to the landscape and build fire resilience.

partners to create a shared understanding of wildfire hazards and benefits and realistic expectations for wildfire response. Tactics for meeting response strategies would be left to the Incident Management Teams to carry out the work, but the strategies themselves would be determined locally and with long-term land management in mind.

For the past three years a group of researchers from the USFS Rocky Mountain Research Station, Oregon State University, and Colorado State University have been collaborating with land managers from the national forest system and their partners to test out a framework that brings together quantitative wildfire risk assessment, fire responder exposure, and operational fire response opportunities to develop risk-based strategic wildfire response zones. These zones summarize information about values at risk and potential fire behavior and spread to allow fire responders to keep all options on the table, managing fire for resource benefit when and where appropriate, and identifying the safest and most effective suppression opportunities when necessary. This risk-based spatial fire planning framework

was first applied to incident response during the summer of 2017 on the Pinal Fire, located on the Globe Ranger District of the Tonto National Forest.

Two years previous, the Simpson fire on the next ridge over had been managed with full suppression and was out in four days, but that was during peak fire season when fuels were cured, winds were active, and resources were stretched by major fires in California and Alaska.

Starts were frequent here, but it had been more than 50 years since the last large fire on this part of the Pinals; and the pine forest had accumulated significant downed fuels and understory infilling. The community of Globe at the base of the Pinal watershed had voiced concerns about the changing forest above them, but the only fires they had been willing to tolerate were a few prescribed burns to clear fuels around cabins and communications towers. It was only a matter of time before a lightning start or a careless match during the pre-monsoon dry season would start a fire mid-slope that would crown and burn off the top of the mountain, including those cabins, TV towers, and some of the only living specimens of bristlecone pine, redwood, and sequoia in the state. A fire like that would

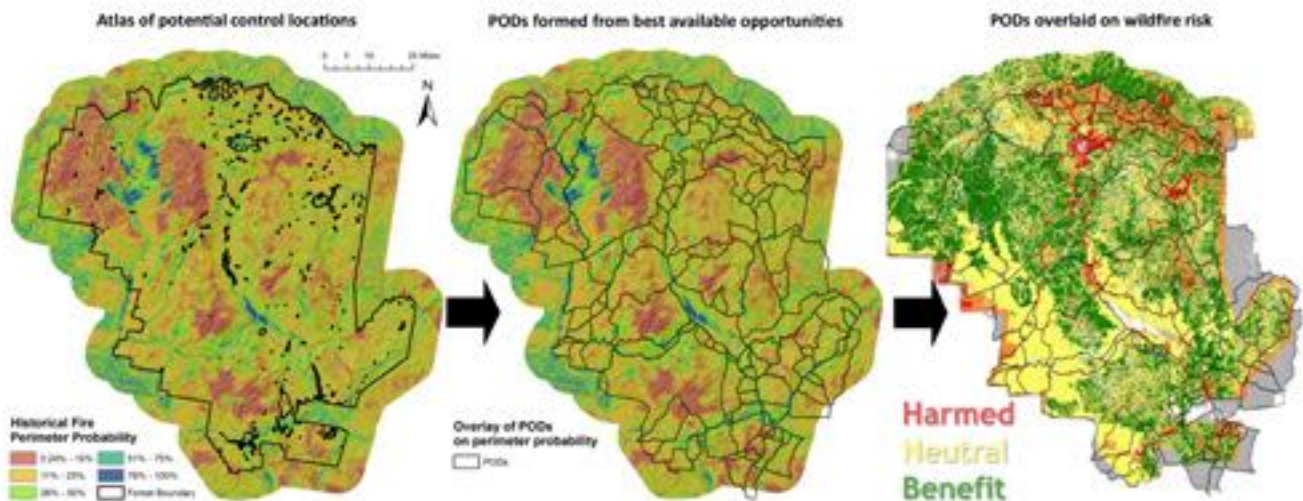
cause catastrophic post-fire flooding for the town below and alter the landscape for generations. The District and community knew something had to change, but perceived risk from past fires precluded managing fire to reduce future risk and improve ecological condition.

A year earlier, the local Central West Zone Type 3 Incident Management Team had worked with the district to the north of Globe to successfully manage the 30,000 acre Juniper Fire to reduce fuel loads and mitigate both flood and fire risk to a youth camp and several private inholdings. For that effort, fire staff from the local team had scouted potential control features over the winter and pre-gamed how a fire on that landscape could be successfully managed. They had gotten lucky with an early June lightning start and the plan had been executed without a hitch, even as ERCs rose to the 97th percentile. The difference on that fire had been significant pre-season planning and no nearby communities at risk. The stakes had been relatively low on the Juniper so uncertainty about fire weather and resource availability had been acceptable. But on the Tonto there were plenty of other places where managed fire was desirable but perceived risks were too high.

A new model for pre-planning fire control locations

About the time of the successful management of the Juniper Fire, researchers from the RMRS Wildfire Risk Management Science Team were developing a model of potential wildfire control locations that was based on conditions where fires had stopped or continued burning in the past. The goal was to leverage data to pre-identify the best available control features for use in fire management operations, much as the local fire staff on the Tonto had pre-identified control features for the Juniper Fire. These control features could then be linked together into a series of fire containers or “Potential Wildfire Operational Delineations”, aka PODs, effectively breaking up the potential for fire spread into a series of manageable chunks.

Another piece of the puzzle that came together at this time was the completion of the Quantitative Spatial Wildfire Risk Assessment (QRA) for all Forest Service Lands in Arizona and New Mexico. The Regional QRA summarizes and maps out wildfire risk (including both positive and negative fire outcomes) for 11 primary classes of natural resources and human assets. While the Team and partners had originally conceived of the assessment as a landscape planning tool, overlaying a map of wildfire risk with opportunities to engage fire was exactly the framework needed to bring strategic wildfire risk into operational incident response.



Examples of the atlas of potential control locations summarized into PODs and overlaid on the results of the forest-scale quantitative wildfire risk assessment. (QRA) product shown here is the conditional net value change in response to wildfire exposure. QRA analysis courtesy of Jessica Haas and Tessa Nicolet.

Over the winter of 2017, Team members met with Forest staff to vet and improve the forest-scale atlas of potential control locations and to downscale risk assessment results to the Forest level, incorporating input from local hydrologists, wildlife specialists, fire staff, and line officers. Through a series of workshops, the mapped atlas of all potential control locations was paired down to a network of 138 PODs bordered by the best available control features on the Forest and near its boundaries. The exercise highlighted the fact that Forest boundaries are often not defensible locations, and that PODs often need to extend onto surrounding ownerships.

The Forest then used this POD network to summarize the results of the QRA into actionable strategic wildfire response zones. While this concept has some similarities to the old “fire management units” designations, strategic response zone boundaries are defined by suppression opportunities instead of land management designations. Each POD can be assigned a strategic response that reflects the relative risk within its boundaries:

- PODs with a net negative projected outcome from fire are classified with an initial response of “protect”;
- PODs with a net positive outcome from fire exposure are classified with an initial response of “maintain”;
- and PODs with condition-dependent outcomes are classified with an initial response of “restore,” where managed fire under the right conditions could eventually convert the POD into the “maintain” class.

On the Tonto, two other strategic responses were developed for PODs representing unique risk profiles:

- PODs where invasive grasses are converting

fire-resistant Sonoran Desert into fire-prone savannah are classified as “exclude”;

- and PODs dominated by naturally fire-adapted ecosystems interspersed with sensitive infrastructure are classified as “high-complexity.” In this last class of PODs, direct engagement with private land owners and targeted fuel treatments could be used to develop new control opportunities, allowing larger PODs to be partitioned to separate resources likely to benefit from fire from assets likely to be damaged by it.

The Pinal Fire – prepared to learn and benefit from a lightning start

In the spring of 2017, several factors aligned to facilitate the decision to manage the Pinal Fire for resource benefit and risk reduction. Completion of the strategic wildfire response zones map provided the tools necessary for the District FMO to approach the county commissioners, city council, and mayor of Globe to discuss managing a wildfire in the Pinal Mountains with a strategy other than full suppression. On the Forest, a fire simulation exercise focused on the top of the Pinals allowed local staff to hone their fire management objectives and to formulate a tactical response prior to the actual fire season. Results from the simulation and the map of strategic response zones and control opportunities swayed landscape partners, setting the stage for the opportunity the Forest had been waiting for.

On May 12, four days after the initial lightning strike, the same local Zone team that had successfully managed the Juniper Fire was assigned to the Pinal, taking over when the fire was 13 acres.

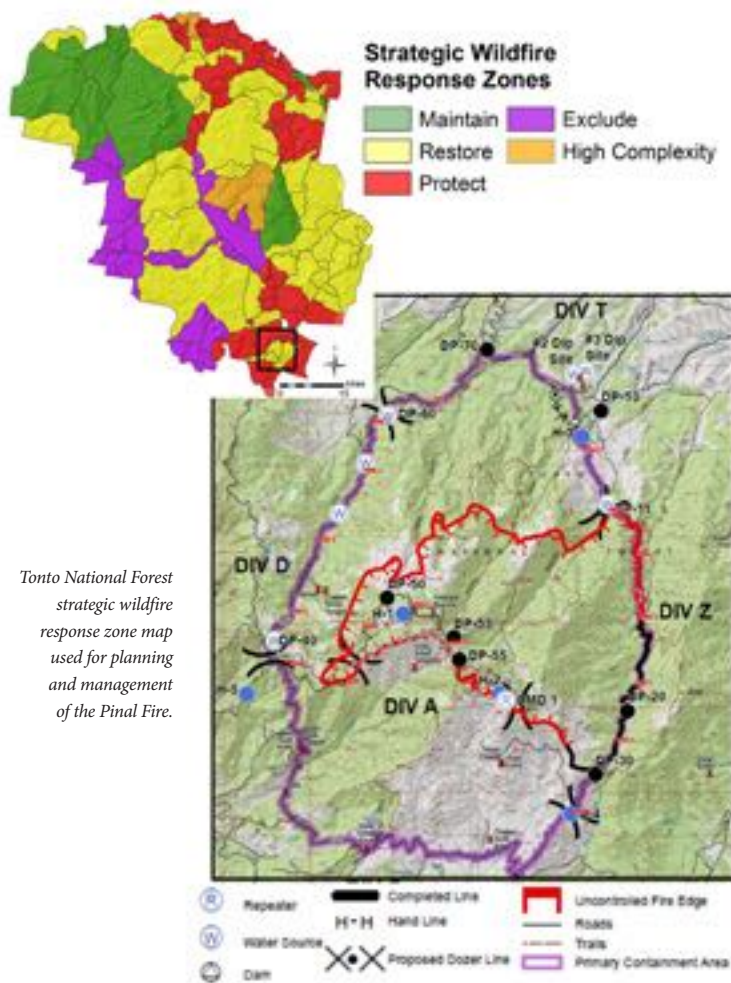
Similar to the Juniper, the strategy was to use backing surface fire to consume abundant downed woody fuels, reduce the number of seedlings and samplings, remove fuel jackpots, and restore fire resilience to the ecosystem. With a clear strategy and well-defined control features, it was up to the operations group to determine tactics necessary to meet strategic objectives. To monitor progress toward the strategic goal of fuel reduction, the Incident Commander brought in a fire ecologist to install and measure fuels transects ahead of burn operations.

But the realities of fire management are never simple. The terrain of the Pinals is steep and treacherous, road access is limited, and within the transition zone from pine forest to chaparral shrubland, decades of accumulated needle drape made fire behavior unpredictable. For the first two weeks of the fire, the incident management team used a combination of aerial ignitions and drip torches to shore up backing stringers and minimize uphill runs and torching through twisting canyons and valleys.

Shrub fuels still had high live moisture and were serving as a backstop to fire progression, though in some areas even the chaparral was underburning. Up top the burn was patchy, leaving some of the heavier fuels only scorched. Overall the fire was meeting restoration objectives but frankly, the fire could have burned a little hotter and torched a little more to open up the dense overstory.

The situation changed on May 24th (day 16). Daytime temperatures jumped 20 degrees, humidity dropped to single digits, the Haines index went to six (on a scale of six), and ridgetop winds surpassed 20 mph. Live fuel moistures plummeted more than 20%; the shrub backstop was gone. By this time the majority of pine forest was already safely in the black, but the chaparral was sending up 50-foot flames, making uphill runs and starting to spot.

Anticipating the change in conditions, a regional Type 1 Team was transitioned in to ensure the planned control lines held. The new team used air support to counter uphill runs in chaparral and a series of back burns to cut off any threat to the private inholdings in the canyon bottom. Within a week the fire had moderated and was returned to local control. In the aftermath, the only patches of high severity had been in the chaparral shrubs, and patch sizes were small enough that BAER Team



Managing fire behavior with night burning. PHOTO: C.D. O'Connor.

rehab took care of any runoff concerns.

From the Forest's perspective, the resulting risk reduction and ecological improvements reversed a 40-year trend of divergence from intended land management direction. While conditions were dynamic on the Pinal fire and will always be variable from day to day during an incident, the combination of pre-planning, strategic assessment, and tactical prowess allowed land managers to make the right decision and end up with a desirable outcome.

Strategic response zones used during this incident and several others over the 2017 and 2018 fire seasons are guidelines for initial response developed locally. Language defining these zones emphasizes land management direction and leader's intent while keeping all options on the table. The risk-based spatial fire planning process used on the Tonto enabled integration of fire operations into land and resource planning by combining local expertise with analytics and fire science.



Fire effects – underburning leaves the canopy unburnt.

PHOTO: C.D. O'Connor.



Re-sprouting after the fire.

PHOTO: Mary Lata, Tonto National Forest.



The fire transitions and the chaparral begins to burn.

PHOTO: Mary Lata, Tonto National Forest.

Understanding wildfire risks in advance and communicating these to landscape partners allowed the Tonto to move a step closer to fire adapted landscapes and communities by engaging many of the political, social, ecological and operational complexities of the Pinal Fire before it even started.

Expanding the pilot to the region, and beyond

With the support of regional leadership, the initial effort on the Tonto has expanded to include all national forest lands in Arizona and New Mexico as well as a series of pilot forests throughout the West. Fire managers on the Tonto continue to find new and innovative ways to leverage these tools to develop large-scale prescribed fire plans, track progress toward desired landscape conditions, and develop or strengthen existing shared fire agreements.

Actions like these are helping to leverage the knowledge of land managers to re-integrate fire while protecting public and private stakeholders. Through proactive pre-season planning and engagement, partners in this effort are helping to leverage safe and effective wildfire response to support resilient landscapes and promote fire-adapted communities.

ABOUT THE AUTHORS

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